Sustainable Land Use in Slovakia

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SUMMARY

Present land use planning level in Slovakia is resulting from the gradual knowledge evolution from soil survey and land evaluation to the sustainable land resources exploitation modelling. Particular attention is concentrated to the quantification of sustainable land use system parameters in different pedo-ecological conditions.

The fundamental basis for the solution of these questions is detailed database not only about soils and land components properties, but about both, real and potential crop yields on representative set of fields, including basic economic soil management data as well. The specific aims of land use efficiency modelling are expressed in the synthesis of both the ecological and economic assessment of soil and land productivity potential. Sustainable land use and farming system models with the economic efficiency calculations are the final results. The set of presented models and maps including economic efficiency calculation enables to apply new concepts of sustainable land use in wider rate as well in agrarian landscape managing.

KEY WORDS

sustainable land use planning and modelling; soil/land productivity evaluation, Pedo-ecological Units System; typological productivity categorization

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INTRODUCTION

Sustainable land use planning starting point is in knowledge, that every land has its own ecological properties combination, which limited its land use efficiency. Therefore it is no paradox that the biggest errors in land use are originated in the territories, where are one-sidedly preferred only economical interests. Paradox is, that notorious mistakes in land capability exploitation were/are implemented in the time, when already the principles of soil suitability classification are/or have been worked out on the relatively good level. As we are witnesses of not small land devastation and unsustainable land use a question cannot be omitted: Is it ignorance or irresponsibility?

Present land use planning level in Slovakia is resulting from the gradual knowledge evolution from soil survey (1961 – 1972) and land evaluation (1973 – 1980) to the present sustainable land resources exploitation modelling. The particular attention is concentrated to the quantification of sustainable land use system parameters in different pedo-ecological conditions. The primary aim of methodological proceedings solution is in the analysis, evaluation and protection of the land components quality and their relationships harmonization.

PEDO-ECOLOGICAL UNITS SYSTEM

The starting basis for a sustainable land use modelling and planning is the system of Pedo-ecological Units (PEU's). The above units are defined as homogenous land units, which have been mapped on the basis of soil properties, climate and relief evaluation and having their own production potentials. In the framework of PEU's, the following hierarchy of topical and regional units from Basic Pedo-ecological Units (more than 8 000 BPEU's), through 75 Pedo-ecological Regions to 14 Pedo-ecological Sub-areas and 4 Pedo-ecological Areas have been distinguished (Džatko et al., 1973, 1982, 2001).

The PEU's express combination of 11 agro-climatic regions (T), 37 genetic soil sub-types (P), 19 parent material groups (G), 5 soil textural categories (Z), 7 terrain sloping categories (S), 4 gravel content categories (K), 3 soil profile depth categories (H) and 4 territory exposition categories (E). All the BPEU's have been mapped in the scale 1 : 5 000.

LAND PRODUCTIVITY POTENTIAL EVALUATION

The first-rank activity of land evaluation is a quantitative analysis and assessment of land productivity potential, which we understood as the "capability of given land unit (PEU) to admit, to transform, to accumulate and to release the amounts of water, nutrients and energy necessary for growth and production of given plants and ecosystem". The degree of land productivity potential is a function of mutual interactions of all the environmental factors, including human influence in space and time.

Quantitative soil/land capability evaluation is based upon factorial and regression analyses of relationships between crop production and soil/PEU properties. For the land productivity potential determination the synthetic-parametric method has been worked out, which is based on long-term yields analyses and derived parameters values for all PEU components according to the formula:

$$Pp = (P_v + G_v + K_v + H + S_v + Z_v) \,.\, T_v,$$

where

Pp = productivity potential of PEU, P_v ...T_v are derived point values of the PEU components.

TYPOLOGICAL PRODUCTIVITY CATEGORIZATION OF PEU

For practical purposes all PEU's are divided into 4 types and 14 sub-types for their sustainable use:

A type – potentially arable land – PEU's in lowlands and on medium slopes, where it is possible to use all tillage techniques, without the negative land productivity potential and land stability impacts.

AG type – alternating fields – light and very heavy soils that are arable, but protection of their productivity potential and land stability require periodic grassing.

G type – grassland – soils on slopes above 12°, shallow and gleyey soils as well as territories, where combinations of several factors, e.g. gleyey soils and climate, etc. occur.

N type – unsuitable for agro-ecosystems – soils on slopes above 25°, extremely shallow, waterlogged, devastated, etc.

Within these types there are 6 sub-types of arable lands (A1 – A7), 3 alternating fields (AG1 – AG3), 4 grasslands (G1 – G4) and 1 N sub-type, which express their productivity potential differences within types, as it is expressed in the following sequence:

A 1 highest productive arable soils
A 2 high productive arable soils
A 3 good productive arable soils
A 4 medium productive arable soils
A 5 less productive arable soils
A 6 low productive arable soils
AG 1 medium productive arable soils and very productive grasslands
AG 2 less productive arable soils and medium productive grasslands

Table 1. Land productivity categories in some lowlands (L), hilly lands (H) and mountains (M) areas in % of farming land

	L 2	H 2	L 1	H 1	L 3	H 3	M 6	M 4	M 7
A 1	35.6	5.4	8.4	1.1	0.0	0.0	0.4	0.0	0.0
A 2	32.3	48.6	18.8	22.4	0.0	0.0	1.7	0.0	0.0
A 3	12.8	14.5	9.4	23.0	11.4	13.6	3.8	0.4	0.0
A 4	3.4	19.2	6.7	19.6	36.0	14.8	9.1	1.3	0.0
A 5	6.1	7.4	20.7	12.7	9.1	38.1	10.3	4.1	0.9
A 6	1.2	0.5	1.6	5.8	1.3	12.6	8.2	9.4	3.7
AG 1	0.3	0.6	0.1	0.3	15.3	2.9	1.2	0.1	0.0
AG 2	0.5	0.3	1.1	2.0	0.7	0.8	3.9	4.4	3.5
AG 3–4	3.7	0.9	28.8	3.0	3.5	1.6	6.9	17.3	17.1
G 1–2	0.0	0.0	0.3	0.0	0.1	0.8	0.7	1.3	1.1
G 3	2.2	0.9	2.7	2.3	20.4	11.5	12.7	21.3	2.4
G 4	1.7	1.5	1.4	6.5	0.1	0.3	30.9	27.2	48.7
N	0.2	0.2	0.0	0.2	0.8	0.4	5.6	2.2	19.3

AG 3 low productive arable soils and less productive grasslands
G 1 very productive grasslands
G 2 medium productive grasslands
G 3 less productive grasslands
G 4 low productive grasslands
N unsuitable for agro-ecosystems

The concrete examples of different structures of land productivity categories in some lowlands (L), hilly lands (H) and mountains areas (M) are given in Table 1.

PRACTICAL APPLICATION OF THE LAND USE MODELS

Visible soil erosion and soil degradation symptoms are very strong arguments for the mark able land use and cropping changes in some regions. On the basis of these data we can quantify more precisely a gradual decrease of the productive arable lands (subtypes A1 – A5) from lowlands to mountains regions and the increase of grasslands subtypes (G1 – G4). Some detailed data of the recent state and proposed land use structure in some Pedo-ecological Regions are given in Table 2 and 3.

The data on the Table 3 show the comparison of our suggestions with the state of the years 1985 – 1990 and the present one in the same regions of mountain areas. It can be seen in this case that the contemporary cropping structure does not correspond with the sustainable land use requirements. The sustainable cropping structure in these regions is based upon the decline of cereals and corresponding increase of permanent fodder crops.

A correct understanding of inevitable land use changes is facilitated by economic argumentation. It

Table 2. Recent and proposed land use structure in some Pedo-ecological Regions in mountain areas in % of farming land

		M 49	M 48	M 46	M 45
Arable land	Recent	58.1	34.9	31.4	22.6
	Proposal	48.1	27.3	22.9	18.6
Grassland	Recent	36.9	60.9	66.7	75.7
	Proposal	46.7	68.5	75.2	79.7

Table 3. Cropping structure on arable land in % of farming land

Crop	Period	M 49	M 48	M 46	M 45
Cereals	1985 – 90	49.8	48.7	60.2	58.4
	Present	48.1	54.7	53.8	61.6
	Model	45.9	44.7	42.9	64.5
Potatoes	1985 – 90	9.5	17.2	16.5	15.6
	Present	8.0	12.6	15.8	12.5
	Model	7.4	10.6	12.4	10.6
Fodder	1985 – 90	14.3	12.2	9.3	8.1
	Present	14.3	14.0	6.4	11.8
	Model	22.5	25.8	28.1	30.1

Table 4. Economic efficiency in SKK.ha-1

	M 49	M 48	M 46	M 45
Gains	9751	7015	6822	5367
Costs	7996	5958	5952	4718
Profit	1754	1057	871	650
Profitability rate (%)	21,94	17,75	14,63	13,77

confirms as well the results of the economic efficiency modelling of the same regions (M49 – M45), given in Table 4 (ex Vilček, Džatko 1996). According to these results also/or in the conditions of the full application of the suggested land use changes the securing of an appropriate benefit in these marginal conditions is possible.

CONCLUSION

Present levels of the land capability evaluation and land use planning in Slovakia are the results of gradual knowledge evolution from the soil survey and land evaluation to the sustainable land use modelling and planning. A final objective is the elaboration of sustainable land use system models that will secure the harmonisation between the land properties, land productive potential and human demands. The set of presented models and maps including the economic efficiency calculation enables to apply in wider rate the new concepts of sustainable land use as well in agrarian landscape managing.

Present knowledge of proposed land use models realization is variable. In the cases of proposed land use changes, adequate ecological and economical effects have been appeared. Is sorrowful that full proposals realization in whole country territory is often influenced by market and economical interests on account of soil and land resources conservation. This evokes new discussion about searching not only economical stimulus, but also juristic and ethic mechanisms that will secure relationships harmonization and conditions for soil and land resources conservation for future generations, too.

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